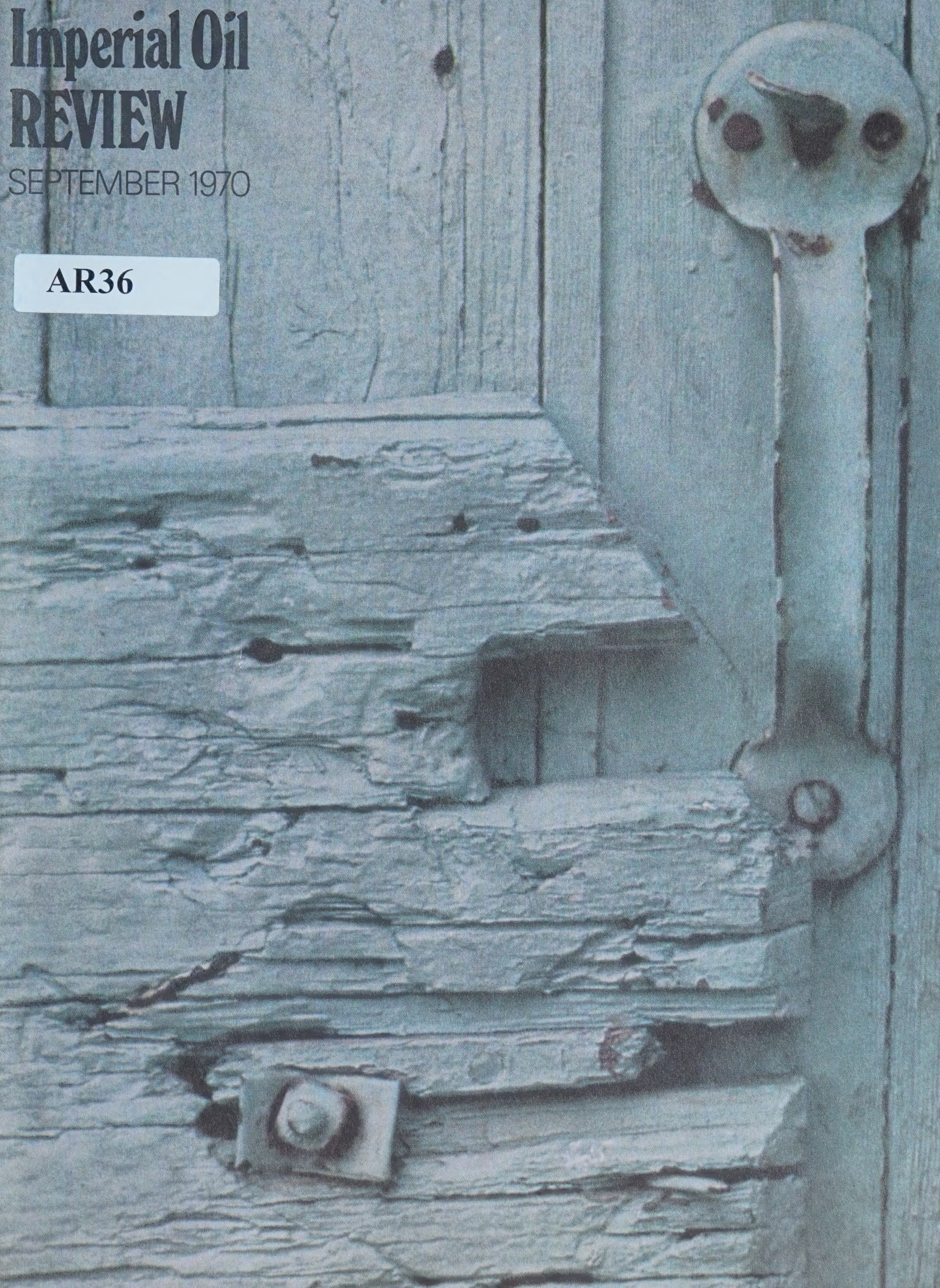


Imperial Oil REVIEW

SEPTEMBER 1970

AR36



in review

The other day a letter came to the Review from a man in Togo, asking if we would mind sending him 20 copies of each issue of the magazine, 10 in English and 10 in French. The man was a teacher of economics and business, and he thought the Review would be useful to his students. With regret, we had to refuse his request.

Togo is a French-speaking republic on the Atlantic coast of Africa, bounded by Ghana, Dahomey and Upper Volta, and it is nice to think of the Review being read there. Among the 100,000-odd copies of the magazine that are printed for each issue, some find their way to almost every corner of the non-Communist world: to Japan, southeast Asia, Australia, the Indian sub-continent and Ceylon, Africa, the near East, western Europe and the Americas. Many of these go to shareholders of Imperial Oil Ltd. and to employees or annuitants living abroad. But a number also go to people who were sufficiently interested in the magazine to write and ask to receive it, and for many years it was the com-

pany's policy to grant such requests, even though they could not be justified in a business sense. Imperial's operations are entirely Canadian.

While the number was small, it didn't much matter. But the number has been increasing and other changes in distribution methods have made the overseas readers into a special group. For example, the brown wrapper that carries most Reviews through the mails is not acceptable for overseas mailing, and those copies need special handling. Consequently, a change in policy is necessary, and the Review can no longer accept requests from outside Canada. We won't stop sending copies to those readers we already have in Tananarive, Tokyo, Tahiti and, indeed, Togo, but we cannot accept new ones.

The Review will still be available, in English or French, to any adult Canadian resident who wants it enough to ask for it. It is for them that the Review is edited—to tell them about Canada, the Canadian petroleum industry, and Imperial's part in it. □

Imperial Oil Review September 1970 Volume 54, Number 4

Editor/James Knight
Designer/Bill Williamson
Cover/Ron Cole: the front door to SS No. 6
(see page 22)

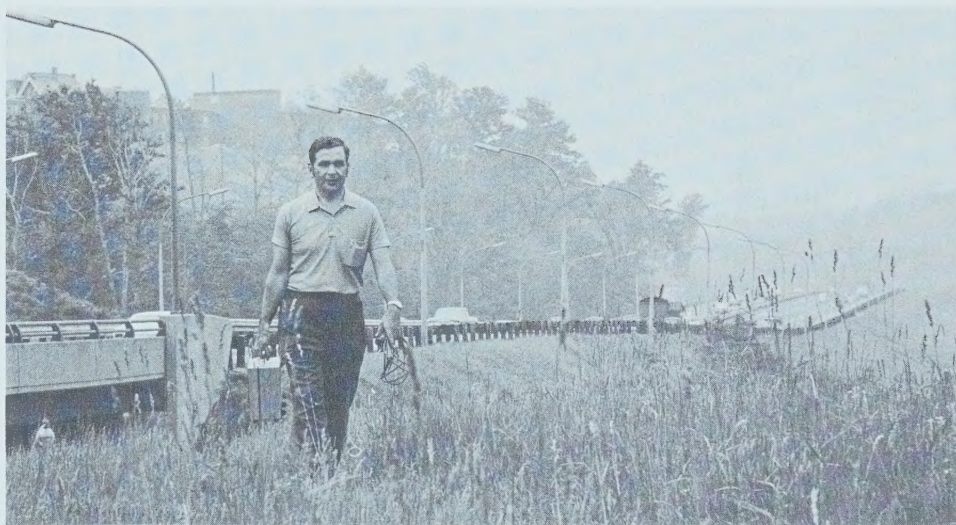
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George Young and the 500

The railroads would have been happy with a diesel lubricant that lasts

Twenty years ago a diesel locomotive was a rare thing to see. Steam was king of the rails. Now, diesels are as much a part of the Canadian landscape as maple trees and TV aerials.

The change from steam to diesel was swift, total and unexpected. Certainly the railways hadn't planned to switch so quickly and their move caught everyone off guard. Along with every other company involved in the operation and maintenance of railway rolling stock, Imperial Oil found itself in the unusual and embarrassing position of being unprepared.

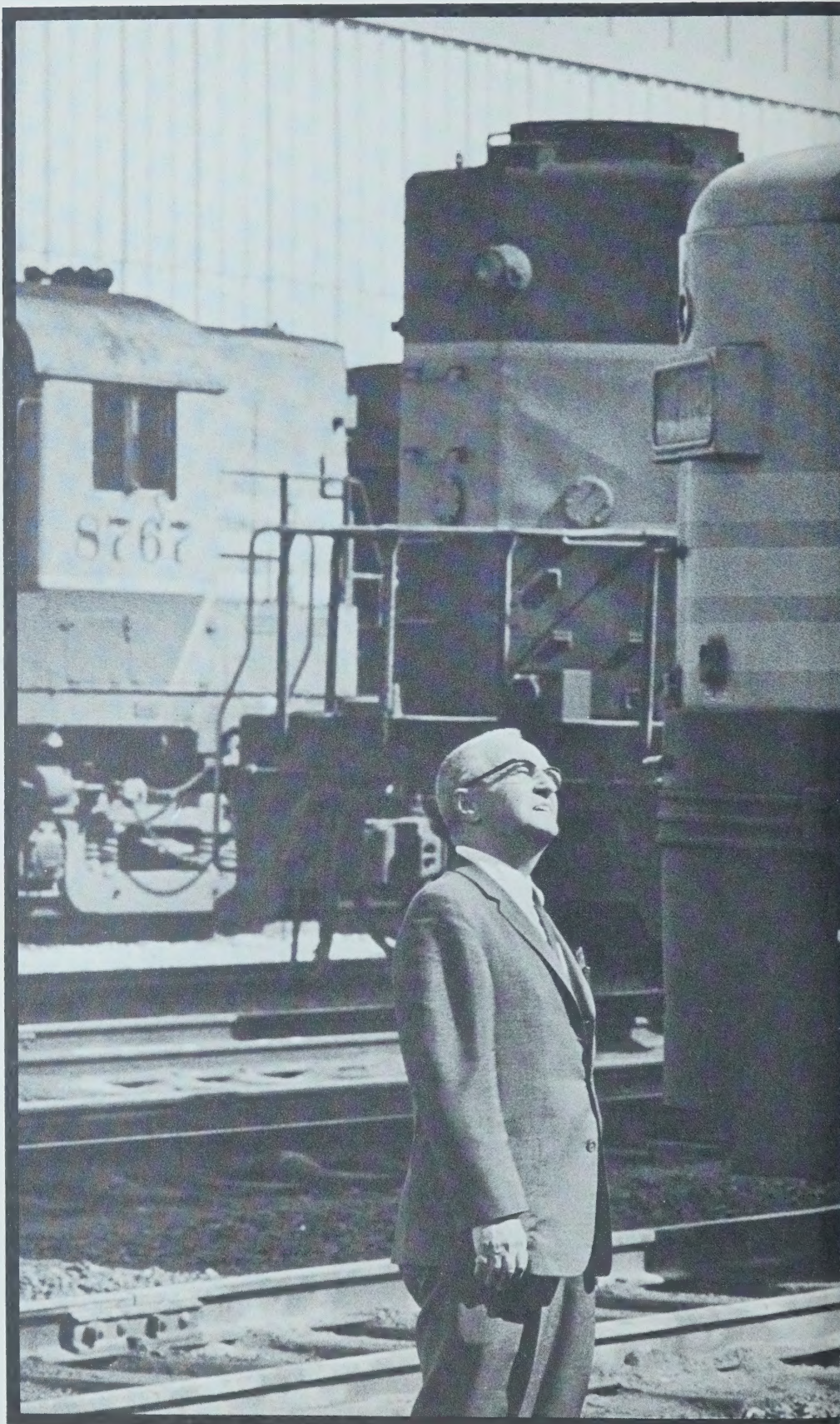
Imperial recovered, though, to the extent that seven out of every 10 diesels rolling across the countryside today are running on an Imperial product called Galena RD-40. RD-40 is a crankcase oil developed to keep Canadian diesels running efficiently; the 'RD' in its name stands for railway diesel.

Galena RD-40 is the latest—but certainly not the last—step in Imperial's continuing search for diesel products that match and surpass the railways' demands. The search has been going on for decades.

Twenty years ago the Canadian railways were planning to replace steam engines gradually. First, the yard engines—those sturdy little workhorses that shunt freight and passenger cars about the marshalling yards—were to be replaced. Then the bigger and more powerful road engines that drag trains on long hauls were to be removed as they wore out and diesels substituted.

This gradual phase-out of steam began in the early 1950s. The railroads planned for a long-range conversion, perhaps as long as 20 or 25 years. But the first yard engines were so efficient that economics forced the railways to alter their plans; instead of a gradual replacement of all engines, the companies converted almost entirely to diesel by 1955.

George Young is one of the men who helped develop the oil that keeps the diesels running



20,000 mile oil change

by H. Stanley
Fillmore

20,000 miles. Imperial researchers developed one four times as good

Ron Cole



The result? The railways were happy; they got better machines that ran more efficiently and more productively. The railways' customers were happy; increased efficiency and productivity meant lower rates for all of them.

The sudden change to diesel meant a real challenge for Imperial. For one thing it meant that Imperial was suddenly in the railway diesel lubricating oil and fuel oil business in a big way. Imperial had been supplying a heavy fuel oil to oil-burning steam locomotives in western Canada, but the market was a small one. By and large, steam locomotives got their power by burning coal. Now a refined distillate petroleum fuel was needed. Just as important, however, was the question of lubricating the diesels. Compared with the complex sophistications of the diesel engine, the steam locomotive was a simple piece of machinery. Lubricating it efficiently was a problem Imperial had solved years before. But the diesel didn't run on the same fuel or the same lubricants as its predecessor.

When the railways introduced the diesel yard engines, Imperial brought out the first of a series of crankcase lubricants, Galena CD-40, the 'CD' for 'crankcase, diesel' and '40' denoting the Society of Automotive Engineers' viscosity classification for the oil, the same SAE classification system applied to motor oils.

For its time, some 20 years ago, CD-40 was a breakthrough. For one thing, it was the first railway detergent oil developed and refined in Canada. Now, 'detergent' as applied to lubricating oils including those you use in your car requires some explanation. In the dictionary sense of 'cleansing' it is something of a misnomer.

Detergent oils contain metal-base additives that don't clean your oil in the same way that a housewife's laundry detergent washes her clothes free of dirt. Rather, the additives—the oil's detergent factor—take the natural build-up of fuel carbon, oil degradation products, and other contaminants in the oil, commonly referred to as "soot" and hold them in suspension in such fine particles that they can cause no harm.

George J. Young, a senior technical railway specialist with Imperial's marketing department and the man in charge of field testing and evaluating CD-40 and its descendants, puts it this way: 'A detergent oil's additives break

Engineer Thor Lonstrup checks the mounting of a new diesel engine to test experimental lubricants at Imperial's Sarnia laboratories.

With higher supercharging, new engines will provide more severe tests for new railroad oils

the soot into such fine particles that they stay suspended in the oil and do not deposit in the engine. In fine suspension they do no more damage to a cylinder wall or to the pistons than blood corpuscles do passing through veins and arteries.'

CD-40 worked fine in the yards switchers. But when the railways began their hasty replacement of road engines as well, a new oil was needed. CD-40 was designed for the short-haul, stop-and-go service of 12-cylinder yard engines, not for the punishing long-distance hauls of the 16-cylinder road diesels.

Back in the laboratories Imperial was working on new formulas, and in 1952 the company brought out a new diesel lubricant, Galena RD-76. It gained almost all of the railway diesel business and stood for years as the standard against which all other locomotive crankcase lubricants were measured.

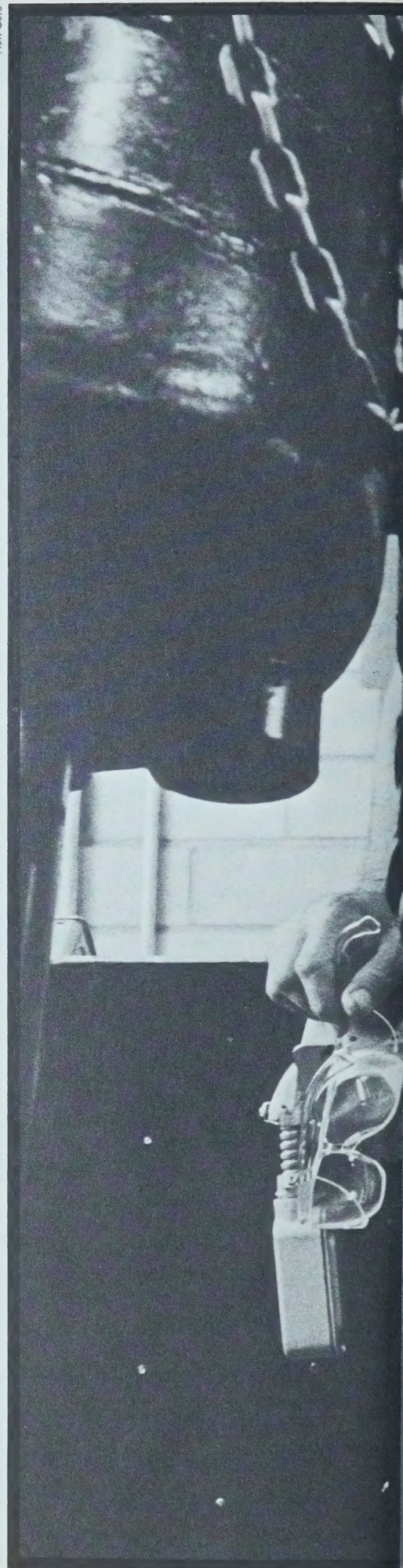
('Galena,' the trade name used in RD-40 and its predecessors, needs a note of explanation. Galena is the ore from which metallic lead is extracted. Before the development of petroleum products as lubricants, galena was used extensively to keep moving parts of machinery running smoothly. The Romans mixed galena with animal fats to lubricate their chariot wheels. In addition, Galena keeps alive the name of the Galena Signal Oil Company, a pioneer in the railroad locomotive lubricating business. Imperial bought the company in 1929.)

But nothing stands still—least of all the manufacture of diesel locomotives.

While RD-76 was successfully lubricating all the existing engines, General Motors and Montreal Locomotive Works, the two main suppliers of diesels for Canadian roads, were modifying and improving their engines.

The improvements took two directions. First, while maintaining the same engine size, both manufacturers increased the horsepower output per cylinder through piston design. Second, they increased the degree of supercharg-

Ron Cole







Diesel locomotives get a complete overhaul at CN's Motive Power Shops in Montreal. Older engines come in at 450,000 miles and the new ones at 550,000, and the oil is changed then. There's a similar shop in Winnipeg

ing. Combined, these two modifications resulted in more power—exactly what GM and MLW wanted. Not to mention the railways. More power meant that one locomotive could do the work that formerly required two, three and often four smaller engines. Perfect.

Perfect, except for one thing: Increased power meant that the engines operated at a higher temperature. And added heat meant a more rapid build-up of soot leading to sticking piston rings.

To compound the problem, the transition to massively-powerful diesels was no slow and easy matter; it took place in a hurry. From 1952 to today the power of diesel locomotives has increased more than 300 per cent, from 800 horsepower to 3,600. And the end is not yet in sight. Both GM and MLW are building even mightier monsters.

During the period when the locomotives grew more powerful, Imperial was moving forward also, experimenting with improved lubricants to meet the increased demands.

By 1962 it was obvious to Imperial that Galena RD-76 was becoming obsolete. To resolve this problem a team was assembled. The two members were George Young of marketing and Thor Lonstrup from Imperial's research laboratory in Sarnia. Lonstrup, a Danish-born engineer, began working with a crew of research chemists to formulate a new diesel lube oil.

Two considerations complicated the task. Consideration No. 1: GM manufactures a two-cycle diesel engine while Montreal Locomotive Works turns out a four-cycle motor. (A two-cycle engine fires and provides power every time its pistons travel up and down the cylinder; the pistons in the four-cycle engine travel the length of the cylinders four times for every power stroke. Thus a two-cycle engine does the same amount of work as a four-cycle in half the time. But it pays the price of running hotter.) CN and CP use both GM and MLW machines; for the sake of convenience neither railroad wanted to stock two different lubricants.

Consideration No. 2: GM builds a silver bearing into a vital part of its engine. Now, silver makes a dandy bearing, but the metal corrodes in the presence of some additives.

Faced with these problems, Lonstrup's crew set to work.

Starting with base oil stocks, various additives in combination were tried and evaluated. Did the resultant oil keep the soot in fine suspension? Were the detergent additives non-corrosive to the GM silver bearing? Slowly, as each product successfully passed the various lab tests, it was subjected to an engine test.

Lonstrup's laboratory is really two labs. The first is what you might expect—row upon row of benches with an array of stainless steel and glass equipment for preliminary checks of viscosity, soot content, operating stability and so forth. But the second, housed in a one-story red brick building behind the main research center, comes as a surprise. It contains a series of diesel test engines. Where the in-use rail diesels are multi-cylinder, the Sarnia test engines have only one. This second lab is as spotless as the first. Each engine operates in seclusion. It is controlled and monitored from behind glass windows.

Each time Lonstrup's team developed a promising new lubricant, the oil was sent to the engine lab. But before firing up for the test, Lonstrup's mechanics had to strip down the engine, measure its parts to fine tolerances, and record its physical specifications in minutest detail. Then the engine was re-assembled, its crankcase was filled with the new oil and it was fired up to run flat out for 200 hours.

The engine was then stripped down again, examined and measured a second time for signs of wear. Operating at full power for 200 hours does not begin to equal the stress that normal railway operation imposes on a lubricant. But it is a sufficiently severe test to give the Sarnia experts a clue to a new oil's capabilities. Those that passed the test went on to further tests, modifications, more tests and more modifications.

Eventually Lonstrup's crew had a product it believed met and passed all requirements. In 1965 the new product, labelled Galena RD-40 was road-tested in six CP locomotives and two on a 193-mile line that connects Quebec Cartier Mining Company's iron mines at Gagnon with Port Cartier on the St.

Lawrence. The engines were fitted with 200-gallon reserve tanks used to top-up the crankcase. They were fully automatic. Pressing a button automatically poured the exact amount of oil required into the system.

In addition, each of the locomotives under test was fitted with clock-recorders hooked into the throttle of the engine. Unlike the infinitely-adjustable foot pedal of the automobile, a locomotive's throttle is limited to eight speeds, each controlled by a notch into which the engineer slips the throttle.

The locomotives were fitted with three timers: one recorded the hours the engine operated in notches 1 and 2, at low speeds; a second clocked the time in notches 3, 4 and 5, the medium-speed range; and the third recorded the operating times for notches 6, 7 and 8, the high-speed range.

After a year of operation and evaluation Imperial knew RD-40 was the product the railways wanted. So far did it exceed the specifications laid down by the rail companies that instead of a complete oil change every 120,000 miles, some locomotives using it have travelled for half a million miles with nothing more than regular topping up. And that's just fine with the railways. When you're dealing with thousands of locomotives, each one of which holds 165 gallons of oil, you don't want to drain the crankcase too often. Besides, after 500,000 miles of operation the railways remove the locomotives and strip them down for overhaul.

The story of Galena RD-40, like all stories, should have an end. But it hasn't.

Although he has his office on the 16th floor of Imperial Oil's head office building in Toronto, George Young spends much of his time in the railway shops across Canada assessing engine performance and helping to plan Imperial's next move to stay on—and hopefully, several jumps ahead of the diesel manufacturers. In a vastly-expanded market bristling with competition, Galena RD-40 holds tight to 65 per cent of the Canadian diesel business. Still, the Sarnia research center is not idle. Lonstrup and his crew are constantly searching for ways to improve RD-40. They're also looking for a superior lubricant to meet the unknown specifications of a super locomotive still not built.

They'll find it. They always have. □



COMBATING

IT BITES HOLES IN YOUR CAR. It sends museum officials running for their armor polish. It causes hydro breakdowns. It can crack a bridge, wreck an aircraft or riddle a pipe line. It works in the air, underground and underwater. It's the silent insidious killer of metals called corrosion and in Canada alone engineers estimate it costs \$1 billion a year in replacement of damaged parts and in prevention. For that kind of money we could foot the bill for the entire federal outlays for health and have \$220 million left over.

Most of us think of it as 'rust'. Actually rust is only the familiar kind of corrosion that attacks ferrous metal: iron or steel. Corrosion inevitably eats away at all metals unless they are protected, just as a neglected rose bush reverts to briar or an erstwhile beauty queen's curves turn to flab unless she does 10BX.

The corrosion process is fairly simple: every metal contains electrochemical energy that seeks to release itself—a restless movement of little particles, called 'ions', to the surface. When the metal comes in contact with a conducting electrolyte—the commonest being air and water—small electrical currents begin to flow through that metal. Parts of the metal, which are dubbed the 'anode' areas, give up the little particles of themselves. And that's corrosion.

In simple chemistry we can see a piece of sodium decompose almost instantly when exposed to air. The metal in our cars has the same tendency to break down but it's a longer process. The corrosion rates of such metals as gold and platinum are infinitesimal, and silver, although it tarnishes easily, corrodes very slowly, too. But a tiny flow of one ampere of

electricity can disintegrate 20 pounds of steel in a year.

Other agents combined with air and water, such as salty or acidic pollutants, help speed corrosion. That's why army staff cars were found in excellent condition in the parched North African desert, 20 years after World War II, while in the humid polluted atmosphere of Toronto or the salty environs of coastal cities, car bodies begin to deteriorate in a year or two. And that's why salt spread on winter roads is hard on automobiles.

In Metropolitan Toronto alone the 80,000 tons of salt spread on the roads annually account for about half the \$75 million in corrosion damage done to cars there (the other half is usually blamed on air pollution). Yet motorists demand ice-free roads and salt does the job better than any other substance presently known. The best anti-rust additives discovered so far reduce corrosion only slightly and cost twice as much as road salt. So, until an effective and economical inhibitor is found, motorists in road-salted areas must simply keep washing, waxing, undercoating and lubricating their cars regularly, and repainting scratches as soon as they appear.

That's how to head off one kind of corrosion. But what about the bridges, skyscrapers and the thousand-and-one places where metal is used in industry? Corrosion prevention is a major concern of oilmen, metallurgists, car manufacturers, airlines, indeed any firm that uses in its products a kind of metal that will readily corrode. Entire engineering companies are devoted to corrosion problems for, according to Thomas Watson, president of Corrosion Service Co. Ltd., 'The engineering profession at large still does not fully understand either the mechanisms of corrosion or the means to control it.'

Luckily, some metals take care of themselves by automatically forming their own surface coating. Pure aluminum oxidizes rapidly in the air to form a transparent protective

In the jungle-like setting of Toronto's Don Valley, technologist Dave Lemon checks the equipment that measures corrosive electric currents

by Albert Martin
photos by Ron Cole

The war against corrosion can never be won, but there are ingenious ways to postpone the last battle

CORROSION

film of aluminum oxide, about one-ten-millionth of a millimeter thick. Copper also forms its own oxidized shield, which accounts for the pleasant mossy-green hue on the roofs of Canada's Parliament Buildings and such venerable hotels as the Chateau Laurier. Stainless steel sets up an invisible insulating film only one molecule thick.

Much of the effort among corrosion fighters is directed at helping metals form this kind of protective coating, or at setting up artificial surface shields. The oil, paint and chemical industries produce lubricants, paints and waxes to protect the surfaces. The Steel Company of Canada has developed Stelcoloy, a low-alloy steel that, in its unpainted condition, forms its own oxide—a permanent blue-brown film that is claimed under certain circumstances to be four to six times as resistant to atmospheric corrosion as plain carbon steel.

The Ford Motor Company of Canada combats rust in Mavericks by using electrical current in 'paint-plating' the vehicle: the current attracts paint particles to the metal when the prime coat is applied, ensuring a more complete coverage than conventional painting provides. Chrysler, American Motors and General Motors all employ multi-coat finishing that includes anti-rust ingredients. Chrysler has designed aluminized mufflers. Rolls Royce has corrosion-resistant galvanized steel in such vulnerable areas as the underframe.

Aggravating though it is to motorists, the corrosion assault on cars is nothing compared to the damage it does to ships. Two corrosion engineers now spend all their time on Imperial Oil's marine problems. Ernest Bustard, superintendent of construction and design in the marine division of Imperial's transportation department, says the company's fresh-water

ships need an exterior paint job every four years; its salt water vessels must be painted annually.

A more sophisticated protective system, the 'sacrificial anode', is used on many ships including the Imperial Vancouver, which sails west coast waters made acidic by pulp mill effluent. This process means literally sacrificing one type of metal to protect another. A hundred years ago British ships used zinc plates attached to the copper-sheathed hulls; the zinc suffered the corrosion and spared the copper. Today ships such as the Vancouver have a network of platinum anodes on their hull. A small amount of direct current is fed into the network from the ship's electrical system, forcing the long-lasting platinum to serve as an anode. Thus the ship's hull is saved from the corrosive giving-off of particles of metal.

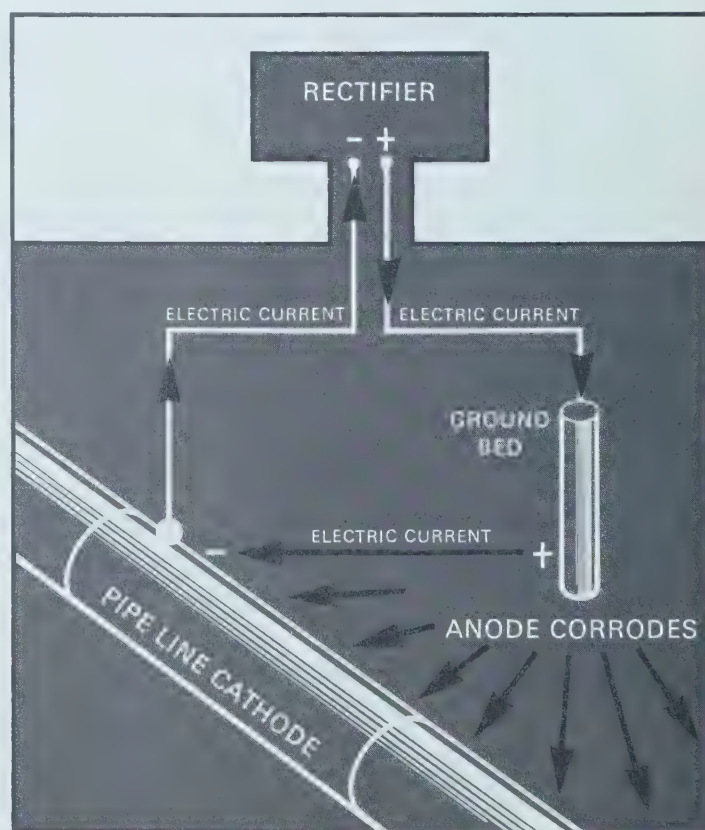
Interior corrosion on board ship is even more serious. Here again, sacrificial anodes, sometimes of high-purity zinc or a special alloy of aluminum, are planted inside tanks and bulkheads. There are also such special protective coatings as Rust-Ban 191, containing zinc powder in an inorganic silicate matrix that is wet-sprayed on interior bulkheads and tanks. When overcoated with an epoxy-mastic, Bustard says it can be expected to last at least 10 years.

Refineries have a particular problem with hydrogen that can diffuse through steel at low temperatures—up to 500 degrees Fahrenheit—to build up in pockets of the metal and form blisters. To fight it, refiners dilute their hydrocarbon streams with water, then remove the water later. At higher temperatures the hydrogen decomposes the iron carbides in steel vessels to form little blisters of trapped methane; the only solution to this problem is to avoid it through the use of

Stray currents from streetcar lines corrode pipe lines. Current from Toronto trams can be detected in Waterdown, 50 miles away



Rectifiers fight corrosion by forcing current to flow through sacrificial anodes towards a pipe line; the anode corrodes instead



resistant molybdenum and chrome steel alloys.

Meanwhile, the men who watch over the 13,000 miles of pipe lines in which Imperial has an interest face problems of their own. There's corrosion underground too, so pipe lines must be coated with primer, then enamel and an impregnated felt paper or perhaps a heavy plastic sleeve or wrapping. Where stray electric currents are present—a problem wherever pipe lines run through cities (the currents from Toronto's streetcar lines can be detected in Waterdown, more than 50 miles away on Imperial's Sarnia Products Pipe Line) sacrificial anodes are buried with pipe lines or counter-currents are set up with a cathodic protection rectifier system, because a coating isn't guaranteed protection. Dave Lemon, a corrosion technologist with the Sarnia Products Pipe Line, spends part of every month in the Don River valley where it runs through Toronto, on a continuing study of stray electric currents that affect the line. He worked on the design and installation of a system that records the current that is being safely drained from the pipes to the rectifiers. The system is monitored twice a week.

Certain kinds of soil bacteria love to feast on some types of pipe coatings, and if even a pinpoint of metal pipe line is exposed corrosion will begin. There are also bacteria that cause corrosion of steel oil well casing by reducing sulfates in crude oil to sulfides that attack the steel, rather like the way bacteria in the mouth produce acids that corrode teeth. The oil well bacteria can live without oxygen in water as hot as 150 degrees. Chlorine kills them.

But corrosion isn't *all* bad. It's a mixed blessing in such places as Toronto's Royal Ontario Museum. Every two or

three years the museum has to refurbish its rusting suits of ancient armor. Acidic pollution from the traffic-clogged streets outside is a hazard to all museum metals. And acid is one reason for the Do Not Touch signs in museums: the natural acids from a thousand clammy hands would hasten the corrosion of prized displays.

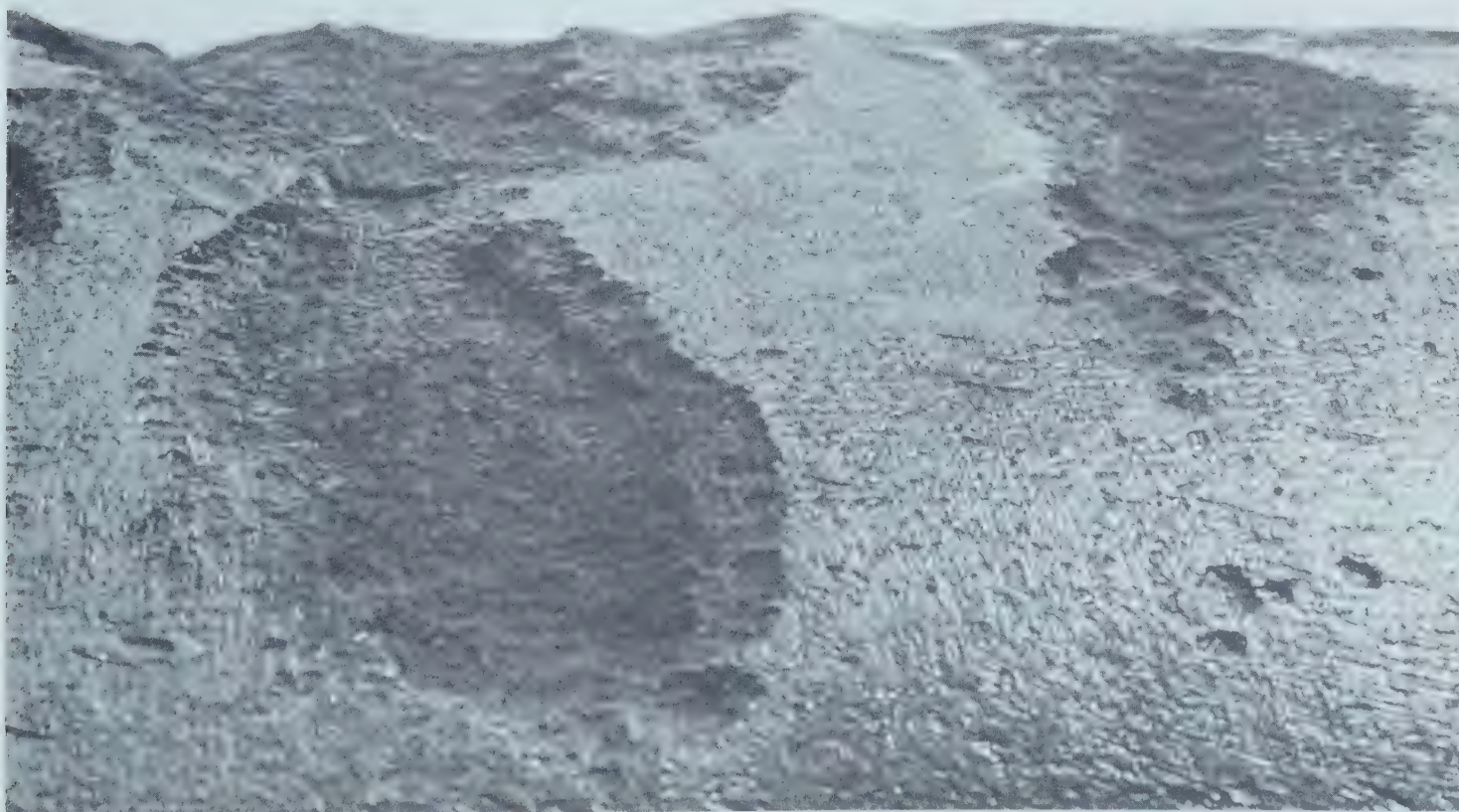
'An ideal museum for metals would be one where the atmosphere is fully controlled and humidity doesn't exceed 30-35 per cent,' says Bernard Leech, the Royal Ontario Museum's assistant curator in charge of conservation.

Although the museum doesn't have complete climate control, it does have some humidity controls, uses 'vapor phase inhibitor' paper in some display cases, and can coat valuable metal pieces with protective lacquers.

And as Leech points out, there's a bright side to the subject. Corrosion has put a surface on objects that makes them more valuable and beautiful. For instance, old bronzes and statues are handsome in their corrosion colors. Early man used blue malachite from copper, rusty red oxide from iron and green chlorides to decorate himself and some of his possessions. Old glass, unlike modern glass, often had bits of free metal trapped in the silica. The corrosion of that metal gives the glass a much-prized multi-layered iridescent appearance.

Adept though we are nowadays at slowing corrosion, we're nowhere near routing it. Ours is the most corrosive age in history, says Bernard Leech. The past 50 years have been more damaging to metal than the previous 19 centuries. The battle will continue for a long time, as man takes metal from the ground and shapes it for his use—and corrosion relentlessly tries to turn it to dust and return it to land and sea. □

Unprotected pipe can corrode rapidly. A current of one ampere (a two-cell flashlight has a current of .3 amps) can corrode 20 lbs. of steel a year



Fast Trains

A new age is dawning for the railroads that may make the wheel obsolete

As the 20th century began, automobiles were still a joke, airplanes were the toys of madmen and, in all of man's endless and historic efforts to perfect land transportation, nothing could match the railroad engine. The mighty, the magnificent, the gloriously belching, panting, whistling trains. They had opened up entire continents. They were the sound of the future, but just as they appeared to be barreling into their most glorious era they ground to a halt.

Automobiles came along and lured away 85 per cent of all inter-city travel in North America; airplanes and buses compete with trains for a share of the remaining 15 per cent. Together trains, planes and buses sucked in billions upon billions of dollars for research and new equipment. Now many passenger trains have come to a permanent halt; and, for a quarter of a century the whole great, sad, old business has been sliding down a long, sure decline. In 1944 rail-

roads in Canada registered about 6.8 billion passenger miles; in 1968, the figure was down to about 2.6 billion. Last November, the CNR and CP Rail filed 31 applications with the Canadian Transport Commission seeking relief from the burden of uneconomic passenger trains. They estimated that for the year 1968 alone these services caused losses of almost \$42 million.

But today, when passenger trains appear to be all but dead, strange and

Canada's entry in the Great Train Race of the 70s is CN's Toronto-Montreal Turbo



by Harry Bruce



even revolutionary ideas are stirring in the world's greatest railroad companies, and governments are pouring millions of dollars into railroad experiments that verge on the fantastic. Ironically, the railroads' second chance stems from the success of both the automobile and the airplane. There are enough automobiles on American roads now to seat the entire population of both the United States and continental Europe. A truck moves at a slower pace today in downtown New York City than a horse-drawn cart did 60 years ago. A full quarter of downtown Los Angeles is

paved. The world's busiest airports continue to get busier, and the big planes back up more and more on the ground and in the sky.

If there is to be a second age of the passenger train, its harbinger is unquestionably Japan's New Tokaido Line, one of the more astounding feats of engineering in the history of transportation. The New Tokaido cost about a billion dollars. It runs between Tokyo and Osaka and, in most important respects, it is the best and most successful railroad in the world. Aided by a computer control center in Tokyo, 36 express trains

make the three-hour-and-10-minute Tokyo-Osaka run each way every day. Locals, making 12 stops and taking an hour longer, daily run 54 times to Osaka and 56 times to Tokyo. A total of 182 trains make the 320-mile run every day, usually only 10 minutes apart, and at speeds that can reach 125 m.p.h.

There was a single day last year on which the New Tokaido moved more than 350,000 passengers. The line began regular service in October, 1964, and by 1967 it had carried 100 million passengers. That year its profits passed \$100 million and by March of 1969 was reported by the Japanese National Railways to have reached an accumulated total of \$248 million. Revenue from Expo 70 is bound to help expand the New Tokaido throughout almost the entire length of Japan. The first extension, a \$472 million, 100-mile route from Osaka west to Okayama should be in operation by 1971 or 1972. It will include 30 tunnels, one of them 10 miles long, and Japanese engineers are confident that the trains on this new leg will routinely hit speeds of 170 to 180 m.p.h.

No freight trains run on the New Tokaido tracks, nor even the slower passenger trains. There are no level crossings and no sharp curves, and no other railroad lines cross the track. The whole operation works so smoothly that the engine operators, aside from some gentle

Meanwhile freight just keeps on making money

Passenger train service has become an increasing financial burden for railway companies over the years, but not freight train service. Shipping freight by rail is still an economical, efficient way to move goods. It has its limitations, of course. A. L. Burns, manager of freight services for CN's St. Lawrence region pointed out in a speech last year that: 'No train can match the low cost performance of a ship, the convenience of an automobile, the flexibility of a truck, the speed of a jet aircraft, or the automation of a pipe line. On the other hand, ships can't wander away from the water, automobile travellers can't really escape the risks of highway driving, trucks can't be coupled together and run a hundred at a time, jet aircraft don't have much of a payload, and our refrigerator manufacturers still can't get their product into a pipe line.' And that's why most Canadian shippers still look to the railways for transportation. 'About 42 per cent of Canada's freight moves by rail,' said Burns, 'compared to 27 per cent by water, 22 per cent by pipe line and nine per cent by highway. Less than one per cent is airborne.' Rail freight service has almost always made the most money for North American lines, and with the advent of 'piggyback' services, containerization and unit trains, the rail freight business never had it so good.

Piggyback traffic—that's where trucking companies make use of rail lines to send loaded truck trailers over long distances—began in Canada in

the early 1950s. In 1968 Canadian National introduced an all-piggyback train service between Vancouver and Toronto-Montreal. Last year, piggyback service was initiated between Prince Edward Island and the mainland.

Containerization replaces truck trailers with big boxes that can be transported by rail, water or highway with equal ease. In 1969, both CN and CP Rail expanded their container handling capacities and began new services.

Unit trains handle large-volume shipments such as ore and minerals. A unit train is, in effect, one big freight car. The entire train is one shipment, going to one destination. When the freight is delivered the empty train returns to the start for another load. Next year, in October, Imperial Oil will inaugurate the world's first unit train for oil transportation. It will run between Douglas Point, Ont., and Imperial's Montreal East refinery, delivering heavy fuel oil to the new Bruce heavy water plant at Douglas Point.

Freight trains have always made more money than passenger trains. Freight accounted for 73.5 per cent of Canadian National's revenues last year, against a meagre 7.4 per cent for passenger service. The spread wasn't always so great. In 1929, CP Rail revenues amounted to \$140 million for freight and \$57.5 million for passenger trains. By 1969, passenger train revenue had shrunk to \$21.9 million—while freight revenues soared to more than \$500 million.

Japan National Railways





CN's Montreal-Toronto Rapido—two trains a day each way—travels the 335 miles in four hours and fifty-nine minutes. It hits 90 miles an hour

On its new track, Japan's New Tokaido express hits 130 mph. Trains run every 10 minutes, and 182 make the 320-mile Tokyo-Osaka run every day





Y. Broncard

France's Capitole express does the 443 miles from Paris to Toulouse in six hours, and hits 125 mph



Penn Central

Reclining swivel seats and meals in the coaches helped make Penn Central's Metroliners popular

The Edinburgh-London Flying Scotsman, with a 3,300 hp diesel-electric locomotive, runs at 100 mph

British Rail



accelerating and braking, have very little to do.

Canada has nothing to compare with the New Tokaido—nor, for that matter, has any other country—but, on the Canadian National Railways' Toronto-Montreal run, things are happening that are intriguing the more serious railroad-watchers all over the world. One of these is the Rapido service, a crack diesel-powered operation that hits top speeds of 90 m.p.h. and covers the 335 miles between the two cities in a minute under five hours. All seats are reserved aboard the Rapido at fares ranging from \$9.90 for a coach seat to \$19.90 for a club car seat, with lunch or dinner, and the train is remarkable not only for the fact that its jammed passenger cars prove that an intercity train service can be profitable, but also for something called the Bistro car. The Bistro is a kind of rocketing bar, sandwich house and nightclub. Its theme is the Gay Nineties, and it honors the period with old railroad brass, gas lamps, waiters in canary yellow vests, and a professional honkytonk piano player to inspire a happy, singalong atmosphere.

The other extraordinary development on Canada's busiest railroad track is the star-crossed TurboTrain. The Turbos were designed to travel from Montreal to Toronto in three hours and 59 minutes at an average speed of 84 m.p.h., and they could easily achieve speeds of 120 m.p.h. But there were serious bugs in the electrical systems, the trains were frequently hours behind schedule, and other minor disasters and afflictions caused the CN to withdraw the trains from service after only about three weeks of public operation.

That was in January of 1969 and it was May, 1970, more than a year later, before the Turbos were back in service.

Like the Rapido and the New Tokaido, the TEE trains of western Europe are a pretty emphatic denial of the idea that passenger trains are dead. TEE means Trans-European Express, a co-operative venture by railroad authorities in Holland, West Germany, Belgium, Luxembourg, France, Switzerland and Italy. The 24 TEE trains—with scarlet and cream-colored aluminum cars, and electric propulsion—can reach 125 m.p.h., and their scheduled speeds average a little below 100. The schedules are fixed to lure businessmen away from planes and cars. The TEE Ile-de-France, for instance, leaves Paris in the morning, arrives in Amsterdam in plenty of time for lunch and an afternoon's business, leaves Amsterdam at the dinner hour, and brings the Parisian executive back home before bedtime.

In North America, the most crucial and fiercely expensive passenger train experiment involves Penn Central Company's new Metroliners. The Metroliner—a silvery-skinned, stainless steel, electrically powered job—began in January of 1969 to streak over the 226 miles between New York and Washington in under three hours. Its average speed is 76 m.p.h. with five stops, 80 m.p.h. with three and, in places, it hits 120 m.p.h.

The Metroliner between New York and Washington and a new highspeed TurboTrain service between Boston and New York are part of a U.S. government investment in the High Speed Ground Transportation Research and Development Program. Under the program, \$71 million in federal funds

has been appropriated, \$13 million of which has been committed to Penn Central's New York-Washington corridor, where Penn Central has spent \$79 million of its own money on equipment and the upgrading of track, station facilities, etc. The point of the investment is to find out if railroad trains can help to solve the transportation problems afflicting not only 'the eight-state supercity of the Northeast Corridor' but many other parts of the United States.

A Pandora's box of engineering bugs and electricians' nightmares plagued both trains, but nevertheless the Metroliners had been running for a full year in January of 1970, and there was no doubt that the train had already earned some inveterate fans. For the first time in more than two decades there was a substantial increase in the number of rail passengers between New York and Washington.

Last June, Penn Central filed for reorganization under the U.S. federal Bankruptcy Act. The company is involved in a wide array of non-transportation ventures, ranging from real estate to 25 per cent ownership of the New York Rangers. Over-diversification in these peripheral areas was cited as the reason for bankruptcy. Nevertheless, the Metroliners are expensive and their future remains somewhat of a question mark in view of the company's financial situation.

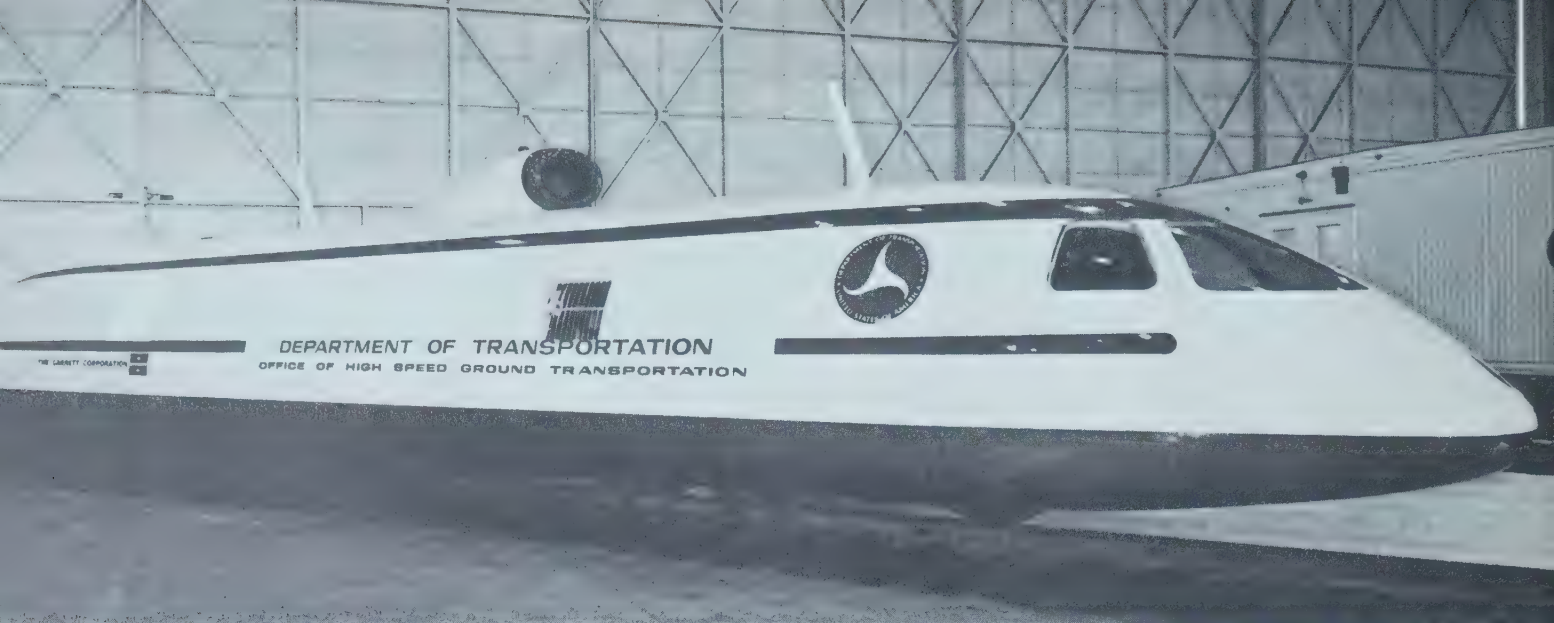
The most extraordinary train of the immediate future, however—the next one to challenge the supremacy of the Japanese supertrain—will probably come from the United Kingdom. British Rail and the British government are together investing more than \$30 million on the development of the Advanced Passenger Train, or APT.

British Rail plans to have two Advanced Passenger Trains in regular service by 1974. They will tear north from London to Edinburgh, a distance of nearly 400 miles, in three and a half hours. Ten or 15 years from now, perhaps as many as 100 APTs will be zipping around the main routes of the British Isles. The APT is expected to hit speeds of 150 m.p.h. and to do it routinely and smoothly. But even a moderate program of track improvement might raise its cruising speed all the way up to 200 m.p.h., and Dr. Sydney Jones, a member of British Rail's board, says: 'I cannot see why speeds of 300 m.p.h. should not be possible.'

In their efforts to win back travellers, some railroads have adopted airline-type hostesses



British Rail



American research car that runs by a form of electro-magnetism is expected to achieve speeds of 250 mph

Railway Age

The central and challenging point about the APT is that, if it works, it will not only be a supertrain, but it will use a track system that is distinctly *unsuper*. The Japanese built a whole smooth new roadbed exclusively for their supertrain, and any country that bets part of its railroad future on vehicles that hover on air will have to spend several hundreds of thousands of dollars per mile to build elevated cement guideways. The APT, however, is an attempt to perfect a train of such extraordinary efficiency that it can hit superspeeds on track systems that may be more than a century old.

Scientists at British Rail tend to regard Canada's TurboTrain as little more than a primitive version of their APT, particularly with respect to the suspension system that will allow the passenger cars to bank like an aircraft as they snap around sharp curves. The key to high average speeds on old and poorly-engineered roadbeds is not so much sensational outbursts on the straightaways as improvement in the rates of acceleration, braking, and taking the curves. The first APT will be tested next year on a 14-mile stretch of track in the Midlands.

But despite British Rail's jolly optimism about the future of the steel wheel, most transportation scientists believe the age of the supertrain will have truly arrived only after trains have broken away from the wheel forever, from the problems of alignment and vibration that rails create, from the friction that remains the one big reason why planes go faster than trains.

In the United States, in the United Kingdom, in Japan, Germany and France, elaborate air-cushion vehicles shaped like missiles are on drawing boards. Models of tracked hovercraft are lifting themselves on their mattresses of compressed air and hurtling through wind tunnels. Miles of full-scale test track, or concrete guideways, are already under construction; and, in France, the first of the real tracked air-cushion vehicles (known as TACVs) are already ripping up and down a 12-mile test track near Orleans. This aerotrain, one of several prototypes designed by French engineer Jean Bertin, is a single car, 84 feet long, that seats 80 people and has reached 180 m.p.h. on test runs. It is powered by gas turboprop engines that drive a propeller. A smaller model, using rocket propulsion, has touched 265 m.p.h.

The test runs have been so successful that 21 countries have shown a strong interest in the aerotrain and the company that has developed it, Société de l'Aérottrain, expects to announce firm orders for two aerotrain lines in France this year. The Canadian government sees the system as a possible jet-age link between downtown Montreal and the huge international airport that's being built at Ste. Scholastique and then, sometime later, as a train that could zip from Montreal to Ottawa and on to Toronto in only two hours. The cars would take off every 10 minutes, and the fare for the whole ride might be \$14. Incredible? Perhaps. But the National Research Council is already examining

the possible effect of the accumulation of snow and ice on normal winter aerotrain operations.

Conventional power systems can provide the forward propulsion for the aerotrain but the Société de l'Aérottrain is also testing a train that's powered by a motor of a sort that may revolutionize ground transportation almost as much as the air cushion. This is the linear induction motor, the LIM, and some railroad scientists talk about it the way medical men once greeted the discovery of insulin or antibiotics. U.S. Transportation Undersecretary James Beggs has said that it could 'herald a new generation of faster, more efficient ground vehicles. . . . As the development of rocket propulsion enabled men to break loose from earth's gravity, so the linear induction motor promises to enable us, on the ground, to be freed from dependence on the wheel.'

Beggs was commenting on the unveiling in Los Angeles last December of a 58-foot, 25-ton test vehicle. It was powered by what the press described as a 'revolutionary magnetic power plant,' and it was claimed to be capable of a speed of 250 m.p.h. The magnetic power plant was an LIM and, put in the simplest terms, the LIM works like this:

An electromagnetic force is generated all along a metal rail in the railway roadbed. This field of force prevents the train cars from settling right down on the roadbed. It repels and supports the train the way an air cushion does. But, at the same time, there is a second direc-



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French experimental aerotrain rides on air, like a Hovercraft, at 150 mph on a raised guideway

tween stations so that the normal air pressure following the train into the tube would boost acceleration further.

None of these schemes will meet all mass transportation needs. In 20 years, British-style APTs may zoom back and forth between Toronto and Montreal, air-cushion vehicles may whip people between cities and airports with unprecedented speed and ease, and linear induction motors may power smooth new commuter services. The automobile may be more hobby than necessity, and the main job left for the airplanes may be to fly really long distances. And even here there are men who see a fabulous future for the train.

One of these men is Dr. Joseph V. Foa. While Professor of Aeronautics and Astronautics at Rensselaer Polytechnic Institute in Troy, New York, he developed a tubeflight mode of high-speed ground transportation in which a vehicle, suspended on a cushion of air, would be propelled through a tube. The tube might be elevated, buried or might even pass through large buildings. The vehicle would propel itself through the tube. Using a propeller or an axial fan the air would be pumped from the front to the rear of the vehicle. As an alternative, since propellers might create clearance problems inside the tube, Foa has also developed a 'bladeless fan' whose 'blades' consist of jets of air emitted by a rapidly turning rotor. Foa's current hope is to see tubeflight operating up and down the east coast of the United States at 350 m.p.h. After that, he says, there's no inherent scientific reason a tubeflight vehicle could not hit speeds of 2,000 m.p.h. Now *that* would be a supertrain. □

tion of power in the electromagnetic force, a ripple effect, a forward-moving flow of invisible waves. The train rides the waves. In a sense, it is itself a part of a huge electric motor. The train and the rail do not touch, the train just glides along. Silently, simply, and very, very cleanly.

Britain, too, is deeply involved in experiments with both the linear induction motor and tracked air cushion vehicles. In 1957, Britain's National Research Development Corporation formed a company and research program called Tracked Hovercraft and, in a way, Tracked Hovercraft is a modest and ingenious answer to British Rail's massive investment in the Advanced Passenger Train. It is already building an eight-mile guideway in eastern England to test an 80-foot, 20-

ton TACV at speeds up to 300 m.p.h.

The tracked air cushion vehicle and the linear induction motor may very well bring us speeds of 200, 300 and even 400 m.p.h. by the mid-1980s. And after that? Well, there's an outfit called Tube Transit, Inc. of Palo Alto, Calif., and its president—a distinguished space and missile engineer named Lawrence Edwards—says there's no sound reason why cylindrical trains could not exploit principles of gravity and air vacuums to hurtle through huge steel tubes. As the tube left one station it would plunge deep into the ground, then rise again to meet the next station. In this way, gravity would provide about 70 per cent of the propulsion and braking power—the trains would literally 'fall' from station to station. Moreover, a near vacuum would exist in the tubes be-

This year British Rail intends to test an air-cushion train like this model. They hope for 300 mph

Railway Age





THE OLD FAMILY SCHOOL

Steve Long's great-grandfather helped build SS No.6 a century ago. Now Steve and his family live there on weekends



It was a warm summer evening in 1968 when Steve Long first saw SS#6, the one-room school where concession 6-7 of Bentinck Township meets the Mulock sideroad, 40 miles southwest of Owen Sound in southwestern Ontario. His first view was from the Baptist church across the road, where he had stopped to pick up the key.

'The sun was just setting behind the schoolhouse — a beautiful sight,' he recalls. 'All I could hear was the church choir practising and faint birdcalls from the trees. It was fantastic. What I wanted was something as much opposite to Toronto city living as I could get and this was it.'

Long's marketing job with Imperial Oil had taken him to the area for the week. An aunt had told him the property was

Steve's grandmother went to school here. His great-grandfather cleared the land. Now the Longs call it home

for sale and since he and his wife were looking for a weekend retreat, he took the opportunity to visit the school.

Long had another reason for wanting that particular school. In 1858 his great-grandfather, John McGillivray, had helped build a log schoolhouse on the 'two chains and 25 lengths square' site. Ten years later it was replaced by a fieldstone building – the one that Long now owns. McGillivray's daughter Flora – Long's grandmother – had learned her ABCs there. Now, a century later, the school would again be a part of the McGillivray family history.

Today, the schoolhouse looks exactly as it did in the 1860s except for new-fangled aluminum storms on the windows. The white flagpole still stands in front of the building. An old bell hangs in the belfry, a gift Steve's aunt bought at a country auction. The school's own bell had been auctioned separately when the schoolhouse was first sold in 1967. Maple trees stand in a row along the wire fence and alongside the old woodshed behind the school. This spring Long planted 125 spruce seedlings. Although he

didn't realize it, he was following an old school custom. For years, the first Friday in May was Arbor Day and classes were suspended as the students celebrated spring by picking up wood chips, sweeping the school yard clean and planting young trees they'd brought from the nearby bush. That's where the maples came from.

Inside the school it's another story : Flora McGillivray would have difficulty recognizing the room where she and her 25 classmates studied. Except for the entrance and the now-padlocked earth toilets flanking it, nothing remains the same. The 600 square feet of floor space has been divided into a living room, kitchen, bathroom and two bedrooms – partitioned by the former owner who had bought the school for \$2,600 from a real estate man who had paid \$1,990 for it at the auction six months earlier. It cost the Longs \$5,050 to buy. The large sunny kitchen, outfitted with new refrigerator and stove, still gets water from the old well, but electricity has replaced the hand pump. In the living room only a stain on the floor marks the place where the wood-burning stove once sat ; the house is heated electrically now.



This is how the school looked in 1905. It was one large room then



Fresh paint gleams on the battered gate





The maples surrounding the school were planted by schoolchildren on Arbor Day—always the first Friday in May



Forsythia and almonds as well as these ancient roses grow by the school

The Longs are taking their time furnishing the place. They plan to fill it with old furniture picked up at auctions in the area. In the fall, they will build a stone fireplace along the wall that once held the blackboard and, some-time in the future, a glass-walled addition to the living room to give them a view north over a farmer's field and a maple grove.

Few people have such personal reasons to buy an old school, but hundreds of Canadians are doing just what the Longs did. As the little red schoolhouse is declining as a place of

Panes in the old windows rattled when the wind blew. Now aluminum storms help keep out the drafts

education, it's taking on a new role: a haven for harassed city dwellers.

In December, 1968, when 29 one-room and two-room schoolhouses were advertised for auction near Trenton, Ont., more than 200 letters and phone inquiries poured in the first week, mostly from Toronto, 98 miles away. On auction day 350 prospective buyers crowded the senior public school auditorium. Some of them hadn't even seen the schools they were bidding for. They wanted them anyway. The school board, which had hoped to raise \$40,000 from the auctions, actually cleared \$72,000.

Old schoolhouses are being sold all across the country. Provincial departments of education are coming to the conclusion that larger school boards can provide better educational programs. Consequently, the little red schoolhouse, with its one or two rooms and its one teacher for all grades, is being abandoned for large, modern, centralized schools built to serve children from miles around. A Newfoundland royal commission on education and youth, reporting in 1967, found that 'small school districts have outlived their usefulness'. A similar feeling exists in all the provinces.

While one-room schools are becoming a thing of the past in the educational sense, these 'monuments to simpler ways and simpler times,' as one newspaper editorial writer described them, are successfully coping with the 20th century in a number of other ways. They are being transformed into community meeting halls or recreation centers, warehouses, artists' studios, Sunday schools, auto body shops or special schools, like the one near Bolton, Ont., which is now an outdoor resource and science school. In Prince

The wagon wheel is a recent acquisition. Long bought 12 at a country auction for a dollar and gave nine of them away





The class picture of 1911. Teacher was Margaret Clark (center) and the Baptist pastor (right) was Rev. A. R. McDonald

Edward Island, priority to buy is given to the tourist department for the preservation of historical sites. The department, for example, has first option on a school in Lower Bedeque where the teacher was Lucy Maud Montgomery, author of *Anne of Green Gables*. The majority of the new owners, though, like the Longs, are creating homes out of the schools.

In the Long's case, SS#6 Mulock has not only become a weekend retreat from Toronto but a chance to practise a different way of living. Steve has made a point of visiting his farmer-neighbors and asking their advice about planting trees, tilling land or sowing their 40-foot-square garden. 'We had seeds for asparagus, tomatoes,

peas, corn, rhubarb, beans, lettuce, radishes and herbs but we didn't know if they were to go four feet into the ground or four inches,' he recalls. He and his wife, Jean, buy their eggs 'up the road a piece' instead of at a supermarket. They are even carrying on an impromptu business — buying neighbors' fresh maple syrup and fat Thanksgiving ducks for their friends back in the city.

In turn, local people are responding to the family's efforts to keep some of the character of the old schoolhouse. Last year when the Longs played host to a community-sponsored final school reunion, 400 former students and teachers came. One of them, Spencer Hopkins, had been a pupil 71 years

before and came partly out of curiosity to see what had happened to the old school. He reminisced about the cold winter days when students and teacher huddled around the stove to keep warm, when the ink froze and cracked the glass inkwells, then — to the kids' glee — trickled all over everything as the room warmed up. He remembered the excitement of box socials and pie socials held in the schoolyard. And spying on teacher as her beau walked her across the field to the farmhouse where she boarded. He remembered lots of things. For that one day, he was again the small boy who trudged the 1 ¼ miles from his farm home to SS#6 school. 'It's nice to see,' he remarked as the day ended, 'that the old place is still serving a purpose.' □

